

Calculating Planet Distances from the Sun Using Kepler's 3rd Law **To the teacher...**

- The following activity has the students verifying Kepler's 3rd Law mathematically which includes a step-by-step solution to a sample problem. (Unlike the "Kepler's 3rd Law Activity" also included in this website listing.)
- Scientific/graphing calculators are recommended.
- **Answer key is available by teacher email request to mmathras@charter.net**



Calculating Planet Distances from the Sun Using Kepler's 3rd Law

Using Kepler's 3rd law formula: $p^2 = a^3$

where **p** is the orbital period in earth-years and **a** is the average distance from the sun in astronomical units (A.U.'s), use the data in the following table to calculate the average distance of each planet from the sun in MILES and then convert to KILOMETERS.

(Now, aren't you glad you asked Santa for that graphing, scientific calculator for Christmas!

Planet	Orbital period (days)	Ave. dist. From Sun (miles)	Ave. dist. (km)
Mercury	88		
Venus	225		
Earth	365		
Mars	687		
Jupiter	4329		
Saturn	10,753		
Uranus	30,660		
Neptune	60,152		
Pluto	90,739		

Hints: --Change orbital period in days to earth years using **365 days=1 year**.

--Convert answers in A.U.'s to miles by using **1 A.U. = 93,000,000 miles**.

--Convert miles to km using **1 mile – 1.61 kilometers**.

Sample Problem: Planet X (fictitious planet beyond Pluto) has been found to have an orbital period of 95,000 days. Find its average distance from the sun in miles and kilometers.

95,000 days/365 days per year = 260.27 years = orbital period = **p**

$$p^2 = 260.27 \times 260.27 = 67,740$$

$$p^2 = a^3 \quad \dots \text{therefore, the cube root of } 67,740 = a$$

a = cube root of 67,740 = 40.76 A.U.'s

40.76 A.U.'s x 93,000,000 = 3,790,680,000 miles (= 3.79×10^9 miles)

3,790,680,000 miles X 1.61 km per mile = 6102994800 km = 6.1×10^9 km

Now, to check your answers: On the classroom computer select START; PROGRAMS; PC's in Space; UNIVERSE; then click the switch to UNIVERSE LESSONS; MATH EXERCISES; Click Button #2 under SOLAR SYSTEM. Follow instructions to check your calculations for your calculated values of

a.